Geophysical Research Abstracts,
Vol. 11, EGU2009-4564, 2009
EGU General Assembly 2009

Climate variability induced uncertainties in simulated mid-Holocene feedbacks

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Previous studies have shown that ocean and vegetation feedbacks, and their synergy in response to the orbitally-induced changes in insolation amplify or dampen the mid-Holocene climate (around 6000 years before present). There is less consensus, however, on the relative magnitude of the two feedbacks and the strength of the synergy between them. This may be an effect of statistical uncertainty caused by climate variability as the common analysis period is only about a century.

To quantify the statistical uncertainty, we performed several sets of simulations for pre-industrial and mid-Holocene climate with the ECHAM5-MPIOM atmosphere/ocean GCM coupled to the land surface scheme JSBACH including a dynamic vegetation module. By using the factor-separation technique, we quantify the contribution of atmosphere-vegetation feedback, atmosphere-ocean feedback and the synergy between these feedbacks to the total mid-Holocene climate signal.

Our results reveal that the statistical uncertainty associated with a 120-year analysis period considerably affects the assignment to the components. When analysing and comparing factors from different 120-year periods, we find that ocean variability can lead to either warming or cooling by synergistic effects.